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ABSTRACT

Fourth through sixth grade children were given two kinds of creativity measures--divergent measures in which the child named all the ideas he could that met a simple requirement, and convergent measures, adaptations of Mednick's Remote Associates Test, in which he attempted to find one word which was associatively related to each of three others. Divergent and convergent measures shared little variance, and the latter were strongly correlated with IQ and achievement. Moreover, convergent items requiring production of the correct association were strongly related to items requiring only recognition. It was argued that in children Remote Associates performance depends on evaluative abilities rather than the size of the associative repertoire. (Author)

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CONVERGENT AND DIVERGENT MEASUREMENT OF CREATIVITY IN CHILDREN

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Abstract

Fourth through sixth grade children were given two kinds of creativity measures--divergent measures in which the child named all the ideas he could that met a simple requirement, and convergent measures, adaptations of Mednick's Remote Associates Test, in which he attempted to find one word which was associatively related to each of three others. Divergent and convergent measures shared little variance, and the latter were strongly correlated with IQ and achievement. Moreover, convergent items requiring production of the correct association were strongly related to items requiring only recognition. It was argued that in children Remote Associates performance depends on evaluative abilities rather than the size of the associative repertoire.

CONVERGENT AND DIVERGENT MEASUREMENT OF CREATIVITY IN CHILDREN

William C. Ward[2]

Educational Testing Service

Mednick conceptualized the creative process in associative terms, seeing it as involving "the formation of associative elements into new combinations which either meet specified requirements or are in some way useful" (Mednick, 1962, p. 221). Individual differences in creativity were seen as depending importantly on differences in the number and relative strength of associates the individual has available that are relevant to a problem. This formulation is schematic--what constitutes an element is not explicated, and several processes by which elements can come into association are mentioned but not explained. It is also limited in scope--the discussion is focussed on the associative substrate required for creativity, and does not include description of the control processes, e.g., personality and motivational variables, that must influence whether and how creativity is manifested in a problem situation. Nonetheless, it has been highly influential, since it provides some link between a highly complex phenomenon and simpler and ostensibly better understood processes.

Two kinds of creativity measures have been rationalized in terms of this scheme. One of these, Mednick's Remote Associates Test, provides the subject with three words and requires that he find an additional word which is associatively related to all of those given (Mednick, 1962). For example,

he is given surprise, line, and birthday; the solution word is party. Subjects presumably attempt to solve the problem by scanning their networks of associations to each of the problem elements and testing whether one of the resultant associations is common to all the networks. The creative subject has more associations available for scanning and therefore has a greater probability of finding the one which satisfies the requirement.

Wallach and Kogan (1965) developed a set of tests in which the extensiveness of the associative repertoire was measured more directly. Their subjects were asked for all the ideas they could give that met a simple problem requirement; for example, to name uses for an object, such as a shoe. Here the creativity measures were the number of relevant ideas, and the number of such ideas which were unique, given to each of their tasks. Following a suggestion by Mednick (1962, Pp. 222-223), they noted that these two measures were likely to be related to one another: ". . . it is quite possible that more frequent associations will occur earlier and more unique associations later in a sequence, so that individuals who are able to produce a larger number of associations also should be able to produce a greater number of unique ones" (Wallach & Kogan, 1965, p. 14).

Mednick's test differs from those used by Wallach and Kogan in that the former is convergent in form, requiring the production of a single predetermined solution to each problem, while the latter are divergent, requiring many solutions. Nonetheless, each operationalization of creativity is seen as a way to test the size and scope of the supply of associations the subject is able to generate given a simple problem; they differ in the

directness of the test of this supply, not in the hypothesized continuum of individual differences that is under examination. It is an obvious prediction, therefore, that the two kinds of performance should be related to one another. If they are substantially intercorrelated, it would provide evidence that the number of associations available is indeed the important individual difference variable underlying performance on the Remote Associates Test. If not, the implication would be that more attention needs to be paid to cognitive and personality variables affecting how the individual operates upon his basic associative repertoire; for example, to differential effectiveness in the use of convergent versus divergent operations (Guilford, 1956), or to differences in the strictness of the evaluation of possible products made by the subject before offering a solution (Frederiksen & Messick, 1959).

The present study provided a test of the relationship of the two kinds of measures in fourth through sixth grade children. Both types of instruments were modified for use in this study. Wallach and Kogan's measures were designed for children of this age, and versions of them have been used successfully with both younger and older subjects (Ward, 1968; Wallach & Wing, 1969). Preparation of the forms of these instruments for use in this study required only making choices among previously used items and setting up an appropriate page format for instructions and test items. The Remote Associates Test, however, was intended for adults. Two equivalent forms of the test were developed for use in this study, using some items taken from an unpublished children's version of the Remote Associates Test (Mednick & Mednick, 1962), plus a number of new items. Half the items in each form were presented as in the adult versions of the

task, while half were given in a recognition format--each could be answered with one word from a list printed at the bottom of the test form. Use of this format served two purposes. First, since recognition items would be substantially easier than items on which the subject had to generate the correct answer unaided, it helped to assure that at least one part of the test would be of an appropriate difficulty level for children at each of the grade levels tested. Second, if both kinds of items should fall at a reasonable difficulty level for the children in this study, the interrelation of the two parts of the test would provide a further test of the degree to which the number of associates the subject has available is the crucial factor determining his level of performance. Recognition items eliminate the subject's need to be able to generate the associative link from his own repertoire, making his ability to evaluate possible answers the more important requirement for good performance.

Method

Subjects. Subjects were the 161 fourth through sixth grade children of both sexes in six classes of a predominantly black urban elementary school. Fourth grade Lorge-Thorndike IQ's, available on 94 subjects, averaged 89.5 (S.D. = 13.5).

Measures. Modifications of two of the creativity measures developed by Wallach and Kogan (1965), the Pattern Meanings and Uses tests, were employed. In the Uses test the child was asked to name uses for a common object; in the Pattern Meanings test, he named possible interpretations of a simple abstract pattern. Two comparable forms of each test were prepared, using items from Wallach and Kogan (1965) and from Ward (1968);

in each case an example was presented, followed by four test items. Each test item was presented on a separate ruled page in a test booklet.

Two twenty-item forms of the Remote Associates Test were also employed. Each item consisted of three words, all associatively related to the same fourth word. Items were randomly assigned to forms and to item numbers within forms. After instructions and four examples, the child was given one page containing ten items in a recognition format. The fifteen words listed at the bottom of the page included the answers to all ten of these items. On a second page were presented ten more items, on which the child had to generate his own answers.

Procedure. The tests were administered to intact classes. Three classes, one each at the fourth, fifth, and sixth grade levels, were given both the divergent and the convergent creativity measures. Three more were given only the divergent measures; the remainder of their testing time was devoted to administration of several personality questionnaires. All classes were participating in a larger study of the development and correlates of children's creativity, and had been tested six months earlier on divergent creativity measures and on the personality questionnaires.

Each class was tested in two sessions during the same week late in the school year. In Session 1, subjects were first given the Pattern Meanings Test, approximately half receiving each of the two forms of this test, and then one form of the Remote Associates Test. In Session 2, they were first given the Uses Test, receiving Form A of this test if they had previously been tested on Form A of the Pattern Meanings Test, and then the second form of the Remote Associates Test. All testing was conducted by the same

female research assistant; a male aide was present during the sessions, and the teacher sometimes remained in the room.

So far as was possible, administrative details were kept similar for the convergent and divergent measures. On the two divergent tests, labeled "What can you use it for?" and "What could it be?", the tester read through the instructions with the subjects, presenting an example item and eliciting responses from the class. The subjects then wrote down their ideas for each item. They were given five minutes per item, a time limit which was generous for most subjects. Children were told not to worry about spelling; the tester and the aide were available to help with wording if needed. The general testing atmosphere was businesslike--children were kept to the task, but with as little emphasis on time limits or on the evaluative aspects of the situation as was feasible.

The convergent measures, labeled "Related Words," were also introduced with instructions, including examples, read through by the tester and the subjects. Each item was then read aloud by the tester; the child had one minute to find or generate the answer and write it in a blank next to the three given words.

Scoring. The Remote Associates Test items were initially scored according to a key containing the intended correct answers. Two judges then examined those answers that had been scored wrong and, in a few cases, agreed that an answer not on the list was acceptable. The Pattern Meanings and Uses Tests were scored for number of ideas--the total number given, less only repetitions, incomprehensible responses, and those judged to be inappropriate. These tests are generally also scored for uniqueness, the number of acceptable

ideas which are given by one child in the sample; but in previous studies uniqueness and number of ideas have been so highly correlated, frequently in the .80's for the two scores derived from the same test, that this score appears to provide little additional information (Ward, 1968, 1969).

Results

There were no systematic differences in means or variances between the two forms of either the Uses or the Pattern Meanings Test; therefore, the two forms of each test were merged without transformation to produce the scores shown in Table 1. Data from each half of each form of the

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Insert Table 1 about here

Remote Associates Test are also presented in the table. Data are displayed here only for the three classes which were given both convergent and divergent creativity measures. It is apparent that all the measures showed a substantial increase in mean level of performance from the youngest class to the two older ones, with little difference between the latter two. To remove class difference effects from the analyses, all measures were standardized by setting the class mean to zero and its standard deviation to one before intercorrelations were computed.

In Table 2 are shown the intercorrelations among the two divergent

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Insert Table 2 about here

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creativity measures, the two forms of the convergent creativity measures, fourth grade Lorge-Thorndike IQ, and the composite score from the preceding

spring's administration of the Iowa Tests of Basic Skills.[3] Similar matrices of correlations were also calculated separately for each sex; no systematic sex differences were found. Each type of creativity measure possessed a high degree of reliability across alternative tests. The two divergent measures, number of ideas on the Uses and on the Pattern Meanings Tests, intercorrelated .72, while the two forms of the Remote Associates Test had an intercorrelation of .82 ($p < .001$ in each case). However, the two types of test had only a minimal relation to one another; their intercorrelations ranged from .17 to .32, with three of the four coefficients significant at the .05 level.

In fact, the convergent and divergent measures shared little variance that was not also shared with IQ and achievement scores. Achievement scores may be a better indication of general ability level in this sample than are IQ scores: They are more recent, the achievement tests having been given one year before the present testing, while IQ was tested while the child was in the fourth grade. Moreover, of the children in the fourth grade at the time of this testing, only those few who had been fourth graders the year before had IQ scores available; thus, there is some selection for less able students in the IQ data. Achievement had a weak positive relation to divergent creativity measures (r's of .25 and .29; $p < .05$ and .01 respectively), but a strong correlation with convergent creativity (r's of .61 and .60; $p < .001$). In Table 3 are shown the partial correlations among divergent and convergent creativity measures with achievement held constant. While all

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Insert Table 3 about here

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the correlations in the matrix were somewhat reduced by the removal of

achievement variance, each type of creativity measure continued to show substantial internal consistency ($p < .001$); and the correlations between divergent and convergent creativity were reduced to negligible magnitude. A similar analysis was done, partialling out IQ rather than achievement, for the 31 fifth and sixth grade students having complete creativity and IQ data. As before, correlations within divergent and convergent creativity remained high (.75 and .73, respectively; $p < .001$), while correlations between these two kinds of measures all failed to achieve statistical significance (average $r = .17$; range from .03 to .31).

Product moment correlations among the recognition and production parts of the Remote Associates Test were also examined. Within each form of the test, these two parts were highly correlated, with r's of .63 for one form and .71 for the other. Across forms, the recognition parts of the test correlated .65 and the production parts correlated .58 (all p's $< .001$). The two kinds of items, finally, showed equivalent relations to standardized achievement scores; for the sum of the scores on the recognition items over the two forms of the test, the correlation with achievement was .65; while for the sum over production items, it was .64 ($p < .001$). Thus, there is no indication that the two kinds of items required different abilities from the subject.

Discussion

It has been a common problem in creativity measurement that one investigator's operationalization of creativity turns out to be unrelated to another's. To some extent, this problem represents differences in the choice of the level of creativity which is under study (Taylor, 1959). The

two kinds of measures used here, however, have been presumed to be measures not only of the same level, but of the same process variable--the number of relevant associations the subject has available in simple problem situations. The Wallach-Kogan measures provide a direct assessment of this variable; and in this study, as in earlier work, these measures proved to possess both substantial reliability across alternative tests and discriminability from general intelligence and achievement measures.[4] Remote Associates performance, therefore, appears to depend less on the size of the repertoire than on those processes involved in evaluating whether a given associate satisfies the problem requirements. Aside from the lack of substantial relation between the convergent and divergent creativity measures, this conclusion is supported by the high correlations between the two parts of the Remote Associates measures. Items on which the subject had to generate and evaluate associations for himself correlated in the .60's with items on which he had only to evaluate alternatives to determine which was correct.

Moreover, the Remote Associates Test shares a large portion of its reliable variance with IQ and achievement measures. This is not a sufficient demonstration that it measures only general intelligence; but at the least the evaluative abilities which are of great importance in determining Remote Associates performance are abilities which are also important for performance on tests of general ability. This conclusion is not totally specific to subjects of the age and ability level in the present sample; Belcher and Davis (1971), testing high school seniors, found a correlation between IQ and the Remote Associates Test of .69; while Warren (1971), using a children's version of the test, found correlations with IQ ranging from .40 to .60 in sixth grade subjects. There is, however, evidence in studies with college

populations showing the Remote Associates Test to be measuring something more than intelligence (Mednick, 1962; Mendelsohn & Griswold, 1966) while still correlating substantially with IQ (Laughlin, 1967). Thus, the only conclusion that can be made with certainty from the present results is that, in these subjects, the convergent measure of creativity depends on processes more complicated than simply the size of the subject's associative repertoire. Whether it measures the same dimension in children as in adults, and whether what it measures in children can be distinguished from general ability, remain to be seen.

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Footnotes

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[3]Most of the correlations presented were computed including all subjects for whom the relevant pair of scores was available. To facilitate a comparison between several breakdowns of the Remote Associates data, however, all analyses involving this test used only the data from those subjects who were present during both days of testing. *N*'s for correlational analyses were reduced by the absence from school of 32 subjects on one or both days of testing and by the incompleteness of the school's IQ and achievement records.

[4]Wallach and Kogan (1965) argued the importance of an evaluation-free testing context for creativity measurement. A definitive test of this proposition has not been made (see Ward, Kogan, and Pankove, 1971). The present results, along with data presented by Ward (1971), suggest that a group testing situation in which time limits are ample and evaluational cues are minimized is adequate for creativity assessment.

Table 1

Mean Convergent and Divergent Creativity Test Performance for Three Classes

Class		Pattern Meanings	Uses	Remote Associates			
		Number	Number	Recognition Form A	Recognition Form B	Production Form A	Production Form B
Grade 4	Mean	14.68	13.37	4.88	4.52	2.00	1.88
	S.D.	7.86	9.22	2.51	3.54	2.14	1.48
	N	28	27	25	25	25	25
Grade 5	Mean	20.46	18.96	6.26	6.83	3.70	4.52
	S.D.	8.81	8.00	3.19	2.93	2.24	2.39
	N	26	25	23	23	23	23
Grade 6	Mean	21.20	19.10	6.84	7.68	4.21	4.05
	S.D.	9.00	9.62	2.32	2.14	2.84	2.27
	N	25	20	19	19	19	19

Table 2

Correlations Among Creativity and Ability Measures

	Pattern Meanings		Remote Asso. A		Remote Asso. B		IQ		Achievement	
	r	N	r	N	r	N	r	N	r	N
Uses--Number	.72***	129	.30*	65	.17	65	.13	65	.25*	98
Pattern Meanings--										
Number			.30*	67	.32*	67	.26*	67	.29**	101
Remote Associates--										
Form A					.82***	67	.49**	35	.61***	44
Remote Associates--										
Form B							.43**	35	.60***	44
IQ									.76***	68

*p < .05

**p < .01

***p < .001

Table 3

Correlations Among Creativity Measures with Achievement Held Constant

	Pattern Meanings	Remote Asso.A	Remote Asso.B
Uscs--Number	.69***	.12	-.10
Pattern Meanings--			
Number		-.19	-.15
Remote Associates--			
Form A			.65***

N = 42 subjects with complete data on all the above measures.

***p < .001